6.0 IDENTIFICATION AND INITIAL SCREENING OF TECHNOLOGIES

6.1 Cleanup Action Objectives

The primary cleanup action objective for the City Parcel Site is to prevent dermal contact with or ingestion of PCB contaminated soils.

A secondary cleanup objective is to reduce any future potential for the migration of PCBs from soil to ground water.

6.2 Federal Regulations Governing Site PCB Remediation

The Toxic Substance Control Act (TSCA) is the major federal law pertinent to the City Parcel Site. TSCA as codified in 40 CFR Part 761 establishes prohibitions of and requirements for the manufacture, processing and distribution in commerce, use, disposal, storage, and markings of PCBs and PCB items in the United States after January 1, 1978. TSCA regulations of importance to this Site are found in 40 CFR Section 761.60 through 761.79, Subpart C: Storage and Disposal. These sections specify treatment, storage, and disposal requirements based on their form and concentration.

The provisions of TSCA apply only to materials containing PCBs at concentrations of 50 ppm and above. PCBs that have been released into the environment after February 17, 1978 are regulated based on the original concentration of the released materials per 40 CFR 761.1(b), generally known as the "anti-dilution" provision of the PCB regulations. However, PCBs at Superfund sites are regulated based on concentrations "as found" at the Site, disposing of the contaminated medium according to the requirements of 40 CFR 761.60(a)(2) to 761.60(a)(5). Consequently, cleanup levels and remedial technologies at Superfund sites are not selected based on the form and concentration of the original PCB material spilled or disposed of at the site prior to initiation of remedial action.

Under TSCA, liquid PCBs at concentrations greater than 500 ppm must be disposed of in an incinerator which complies with 40 CFR 761.70 or by an alternative disposal method that achieves a level of performance equivalent to incineration as provided under 40 CFR 761.60(e). This has been interpreted to imply that treatment residuals must contain less than 2 ppm PCBs. Liquid PCBs at concentrations between 50 ppm and 500 ppm, can be disposed of in an incinerator or high efficiency boiler, or in a facility that provides an alternative method of destroying PCBs that achieves a level of performance equivalent to incineration.

Under TSCA, there are three primary options for non-liquid PCBs in the form of soil, rags, or other debris, that contain PCBs in concentrations of 50 ppm or greater:

1. Incineration meeting the requirements of 40 CFR 761.70.
2. Disposal in a chemical waste landfill meeting the requirements of 40 CFR 761.75.

3. Treatment equivalent to incineration under the performance standards provided in 40 CFR 761.70(b)(1).

TSCA does not specify concentration limits for disposal of PCB-containing non-liquids (e.g., soils), but specifies that industrial sludges or dredged materials with PCB concentrations greater than 500 mg/Kg may not be landfilled. The determination of whether contaminated materials should be considered a soil or an industrial sludge should be made site specifically consistent with the current process for classifying material subject to the land disposal restrictions as either a pure waste or a soil and debris contaminated with a waste.

Disposal of soils, sediments, or treatment residuals contaminated with PCBs in concentrations equal to or greater than 50 ppm must comply with TSCA generator requirements: notification to EPA of PCB-generating activities, shipment of regulated wastes using the Uniform Hazardous Waste Manifest, and disposal at a TSCA-approved disposal facility.

The TSCA regulations for storage requirements, 40 CFR 761.65, specify that materials with PCB concentrations of 50 ppm or greater must be destroyed or disposed of within one year after being placed in storage.

PCBs are not regulated as a hazardous waste under the Resource Conservation and Recovery Act (RCRA). However, if PCBs are mixed with hazardous wastes listed under RCRA, the mixture is subject to the RCRA waste regulations. RCRA is not applicable to the Site because the site soil is not a RCRA hazardous waste.

The State of Washington Dangerous Waste Regulations, Chapter 173-303 WAC, implements Chapter 70.105D RCW, the Hazardous Waste Management Act of 1976 as amended, and Subtitle C of RCRA. PCBs are regulated as a hazardous waste under this regulation.

6.3 Estimated Volumes of PCBs Contaminated Soils

Table 3 shows the soil volume calculations for the Site. Volumes are estimated for soils above 10 mg/Kg PCBs for the parking lot, the alleyway, the south side of the building, and underneath the building. Approximate volumes of contaminated soil as a result of the removal of dry wells DW1 and DW2, and the underground storage tank are included. The volume of surface soil above 10 mg/Kg PCB concentration underneath the building is based on the assumption that the contaminated soils underneath the building are located in the Northern and Eastern addition areas (aerial photographs show that transformers were placed in these areas before the building expansions). Soils in the City of Spokane property do not exceed the PCB industrial cleanup level.

6.4 Treatment of PCBs in Soils

Treatment of PCBs in soils involves the use of a technology that destroys, removes or immobilizes PCBs. Treatment of PCBs in soils can be performed in place (in-situ) with little or no disturbance to the contaminated soils. Ex-situ treatment of soils requires excavation of contaminated soils to be followed by on-site or off-site treatment.

Treatment technologies for PCBs are classified as established, demonstrated or emerging technologies. Established technologies are those that have been employed at the full-scale level to successfully meet cleanup goals at multiple sites; they are commercially available. Demonstrated technologies have been conducted at pilot- or full-scale at a limited number of sites. They have generated performance and cost data on the treatment of the PCBs. Emerging technologies have not yet been shown to effectively or consistently treat PCB soils at the pilot-scale level. They are in bench-scale studies or in pilot-scale level.

6.5 Remedial Technologies or Process Options

The following General Response Actions and appropriate remedial technologies/process options are considered for the contaminated soils at the City Parcel Site:

1. Institutional Controls
   - Deed Restrictions
2. Containment
   - Capping
   - Surface Controls
3. In-situ Treatment
   - Solidification/stabilization
   - Bioremediation
   - Vitrification
4. Excavation/Ex-situ treatment
   - On-site Treatment
     - Incineration
     - Thermal Desorption
     - Chemical Dehalogenation
     - Solvent Extraction
     - Soil Washing
     - Solidification/Stabilization
   - Off-site Treatment
     - Incineration
5. Excavation/Off-site disposal

6.6 Initial Screening

For the initial screening, the remedial technologies/process options in Section 6.5 are screened against the "threshold criteria"; those meeting these criteria will then be screened against the "other requirements" which include cost and implementability.

Technologies/process options that could meet these criteria are retained for the detailed evaluation.

6.6.1 Institutional Controls

Per WAC 173-340-440, institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of an interim action or cleanup action or that may result in exposure to hazardous substances at the Site. Institutional controls may include:

(a) Physical measures such as fences;
(b) Use restrictions such as limitations on the use of property or resources; or requirements that cleanup action occur if existing structures or pavement are disturbed or removed;
(c) Maintenance requirements for engineered controls such as the inspection and repair of monitoring wells, treatment systems, caps or ground water barrier systems;
(d) Educational programs such as signs, postings, public notices, health advisories, mailings, and similar measures that educate the public and/or employees about site contamination and ways to limit exposure; and
(e) Financial assurances.

Institutional controls alone will not attain cleanup standards and thus will not meet the threshold requirements. However, institutional controls are required when a cleanup action results in residual concentrations of hazardous substances exceed Method A or B cleanup levels; when Method C cleanup levels are used; when industrial soil cleanup levels are used; or when a conditional point of compliance is used. **Institutional controls will be retained as a potential component of the cleanup.**

6.6.2 Containment

The purpose of containment is to isolate the PCB-contaminated soils from potential receptors by the use of a physical barrier. The barrier mitigates the exposure hazard by preventing direct contact with the PCBs in soil, eliminating fugitive dust emissions, preventing soil erosion, and reducing the potential for chemical migration into ground water. **Capping** and **surface controls** are two potential options for containment.

Capping involves the construction of an impermeable or permeable barrier over areas of PCB-contaminated soils. A permeable or impermeable barrier would prevent direct contact and ingestion exposures; an impermeable barrier will isolate surface water runoff from the PCB contamination and prevent infiltration of storm water into contaminated soils. Capping would also prevent migration of PCBs in dusts or in soils caused by water erosion. Capping is a reliable technology and can be readily implemented. Caps require periodic monitoring and maintenance to ensure their structural integrity; these can be easily implemented. Capping, when combined with other alternatives, could meet the threshold as well as the other requirements. **Capping is retained as an alternative**.

Surface controls involve soil grading, revegetation, construction of dikes or berms, or other means of controls to divert runoff and minimize erosion. Surface controls would reduce chemical migration but would not eliminate direct contact with chemicals in surface soils. Surface controls would not meet the minimum threshold requirements. **Surface controls will not be retained for further evaluation.**

6.6.3 In-Situ Treatment Technologies

In-situ treatment destroys, removes, or immobilizes hazardous compounds in place. In-situ treatment does not trigger TSCA requirements since the PCBs were deposited in the environment before February 17, 1978 (see Section 6.2 on applicability of TSCA); thus, the primary consideration is the attainment of cleanup levels.

The breakdown of organic compounds by microorganisms is referred to as **bioremediation**. Bioremediation can occur at a higher rate in the presence of oxygen (aerobically) or more slowly under near oxygen-free conditions (anaerobically). **In-situ bioremediation** encourage contaminant biodegradation by enhancing site conditions (e.g., nutrient concentrations, pH, etc.) without substantially disturbing the impacted media.

Historically, PCBs have been considered resistant to biodegradation. However, results of laboratory studies have shown that PCBs do biodegrade in the environment but at a very slow rate. PCB compounds with fewer chlorine atoms have been shown to aerobically degrade whereas the more highly chlorinated are resistant to aerobic degradation. PCBs at this Site represent the more highly chlorinated PCBs. More research on PCBs biodegradation is being conducted but there is no process that is commercially viable at this time. Bioremediation does not meet the threshold requirements. **In-situ bioremediation will not be retained**.

Solidification involves the addition of a binding agent, such as Portland cement or asphalt, to the waste encapsulating the contaminants in solid material. **Stabilization** involves the addition of a binder, such as Portland cement, cement kiln dust, or fly ash to the soil to convert PCBs into a less soluble, mobile, or toxic form. **Solidification/Stabilization (S/S)** processes utilize one or both of these techniques. This treatment method reduces the mobility of PCBs but does not concentrate or destroy PCBs. **In-situ S/S**, the solidification agents are injected into the soils and mixed with the soils using backhoes for surface mixing or augers for deep mixing.

This technology could meet the threshold requirements if combined with institutional controls. PCBs will still be present in the waste but its potential migration is reduced. The long term reliability of the treatment process is uncertain and long-term management controls are required. This technology is easily implemented and the cost for implementation range from $50 to $310 per ton. **In-situ S/S will be retained for detailed evaluation.**

Vitrification can be used to treat soil and sediment containing organic, inorganic, and radioactive contaminants. Heat is used to melt the contaminated soil which forms a rigid, glassy product when it cools. The volume of the vitrified product is typically 20 to 45 percent less than the volume of the untreated soil. PCBs are destroyed by the high temperatures used during vitrification. The destruction mechanism is either pyrolysis (in an oxygen-poor environment) or oxidation (in an oxygen-rich environment). **In-situ vitrification (ISV)** typically uses a square array of four electrodes up to 18 feet apart. The electrodes are inserted or gravity fed into the ground to the desired treatment depth. The electric current flows through the electrodes and generates heat, melting the soils. ISV of PCBs had been demonstrated in some Superfund sites at a cost of $100 to $1000 per ton. There is only one vendor of commercially available ISV systems.

ISV would meet the threshold requirements. However, implementation of the ISV is not possible at the Site since the Site area (at less than 1 acre) is not adequate to accommodate the mobile system with all the ancillary equipment. ISV systems include the ISV equipment, setup areas, and worker's quarters. The surrounding properties are not available for use since the City of Spokane is planning to develop its property adjacent to the alleyway, and the other properties surrounding the Site are commercial establishments. **ISV is not retained for detailed evaluation.**

6.6.4 Excavation/Ex-situ Treatment Technologies

Ex-situ treatment will require soil excavation and either **on-site** or **off-site** treatment. Off-site treatment facilities must be permitted under TSCA.

Compliance with TSCA ARARs requires PCBs, at greater than 50 ppm, be incinerated, treated by an equivalent method, or disposed of in a chemical waste landfill. Equivalence to incineration is demonstrated when treatment residues contain <2 ppm PCB. If treatment is not equivalent to incineration, compliance with TSCA ARARs must be achieved by implementing long-term management controls consistent with a chemical waste landfill.

6.6.4.1 On-Site Treatment Technologies

Incineration is an established remedial ex-situ technology for PCBs and has been the most commonly recommended solution for soils containing PCBs. Incineration is required under 40CFR61.70 to achieve the equivalent of six 9's (99.9999%) destruction removal efficiency. This process treats PCBs in excavated soils by subjecting the soils to very high temperatures (typically > 1000_F) in the presence of oxygen, which causes volatilization, combustion, and destruction of these compounds. Off-gases from the incinerator will have to be treated. On-site incineration costs run from $280-$1000/ton.

Thermal desorption is a demonstrated PCB-treatment technology. It is an ex-situ means to physically separate the PCBs from the soil by heating the soil to temperatures high enough to volatilize the contaminant. Air, combustion gases, or an inert gas is used to strip vaporized contaminants from the soils. The primary stages of a thermal desorption system include excavation, desorption, particulate removal, and off-gas treatment.

Thermal desorption technologies had been selected as the remedial action for several PCB contaminated Sites. Thermal desorption will meet the threshold requirements and will rank high in terms of long-term effectiveness and permanence. The cost of thermal desorption is $90 - $380/ton. Thermal desorption units are available for on-site treatment.

Chemical Dehalogenation technologies, a demonstrated technology, employ chemical reactions to remove halogen atoms (chlorine atoms for PCB) from organic molecules. The BCD or based-catalyzed decomposition process is an efficient, relatively inexpensive process for PCBs. The process can be employed by using sodium hydroxide, sodium bicarbonate, or aliphatic hydrocarbons as hydrogen donors. This process had been demonstrated to be capable of treating PCBs at costs of $225 - $580/ton.

Solvent extraction does not destroy wastes but is a physical means of separating hazardous contaminants from soil, thereby reducing the volume of the hazardous waste that must be treated. The primary stages of the solvent extraction technology are excavation, handling of the soils, contaminant extraction, solvent/media separation, contaminant collection, and solvent recycling. Solvent extraction costs can run from $110 - $540/ton.

Soil washing is an ex-situ water-based remedial technology that mechanically mixes, washes, and rinses soil to remove contaminants. The process removes contaminants from soil by dissolving or suspending soils in the wash solution, or by concentrating the soil into smaller volume through simple, practical separation techniques. The primary stages in the soil washing process are soil preparation (excavation and moving soils to the process) washing, soil and water separation, wastewater treatment, and vapor treatment, if necessary. Mobile soil washing systems may be located on-site but will need space to store the soils, to hold tanks or ponds for wash water preparation and wastewater treatment. Soil washing is a demonstrated technology. On-site soil washing costs run from $60-$230/ton.

Ex-situ Solidification/Stabilization, S/S processes involve (1) soil excavation, (2) classification to remove oversized debris, (3) mixing and pouring and (4) off gas treatment, if necessary. Costs for an ex-situ S/S can range from $50 - $310/ton.

All the above on-site treatment technologies could meet the threshold requirements. However, on-site treatment systems will require the use of mobile treatment systems with all the ancillary equipment including off-gas or other residuals treatment systems. The Site area of less than 1 acre is not adequate for any of these on-site treatment systems which would include the necessary space to store and manage the excavated soils. Areas surrounding the Site are not accessible for use in the cleanup. Because the implementability of these systems is not possible, all the above **ex-situ on-site treatment technologies are not retained.**

6.6.4.2 Off-Site Treatment Technologies

Incineration is performed at an off-site facility. There are a number of commercial incineration facilities capable of accepting PCB-containing soils. Off-site incineration can cost up to $2300 per ton. Off-site incineration would meet the threshold requirements. This is a technology that rates very high in terms of protectiveness, permanence, and long-term effectiveness. Cost can be a concern for incineration. **Off-site incineration will be retained for further analysis.**

6.7 Excavation/Off-site Disposal

Off-site disposal consists of transporting excavated soils containing PCBs to a TSCA-permitted facility. The TSCA permitted landfill closest to Spokane is located in Arlington, Oregon approximately 215 miles from Spokane. Estimated costs for disposal in an off-site landfill are $150-$200 per ton, including transportation. **Excavation/Off-site disposal will be retained for further evaluation.**

Table 4 shows a summary of the initial screening conducted under this section.